

Numerical simulation of the precipitation system observed by a Rainscope sonde

Case: 20 February 2022, Mito

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Suzuki et al. (2022) developed a new cloud/precipitation particle imaging radiosonde, namely, Rainscope, which is able to capture much clearer images than conventional videosondes and to measure the fall velocity of precipitation particles in clouds. They performed test launches of Rainscope sondes several times, including that at 00:18 AM (JST) on 20 February 2022 from Kobuki Sports Park in Mito city, Japan. In this case, the Rainscope sonde went up through a stratiform precipitation area located along the west side of low-level convergence zone distributed from the offshore of Ibaraki prefecture to Sagami bay, and it captured densely-rimed and graupel-like snow particles just above the freezing level and non-rimed crystals at higher altitudes.

To reveal physical processes producing those particles captured in the stratiform cloud, we performed a numerical simulation using Japan Meteorological Agency Non-Hydrostatic Model integrated with the microphysical process-tracking scheme (Hashimoto et al., 2020). The model successfully reproduced the characteristics of observed hydrometeors. As a result of backward trajectory analysis, it is found that air parcels which were firstly located over the south offshore of Kanagawa prefecture traveled across the low-level convergence zone from south to north, then reached Mito. In the convergence zone, supercooled liquid water was produced in convections, and it promoted riming growth of snow crystals. Higher altitudes air parcels finally positioned at over Mito, longer distance and time it needed to travel after crossing the convergence zone, consequently lost the rimed snow particles by gravitational sedimentation during the traveling. In contrast, for air parcels at lower altitudes over Mito, they still kept much supercooled liquid water to produce rimed snow particles. This difference could explain the observed results that small and large contributions of riming to growth of snow particles at high and low altitudes, respectively, over Mito.

Rainscope is able to take clear images enough to distinguish rimed snow particles from others, which is hard for conventional videosondes. On the other hand, the model used in the present study can quantitatively evaluate the contribution of riming process to growth of snow particles, which is due to recent development. Collaborations between such a sophisticated particle imaging radiosonde and numerical model should take us to a new stage for comprehensive understanding of precipitation forming mechanisms.

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References

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